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ORIGINAL ARTICLE

Self-determination, stage of readiness to change for exercise, and frequency of physical activity in young people

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Abstract

Grounded in self-determination theory (Deci & Ryan, 1985) and the transtheoretical model (Prochaska & DiClemente, 1983), the aim of this study was to examine the relationship between exercise regulations varying in self-determination with stage of readiness to change for exercise and physical activity patterns in university students. A cross-sectional survey design was used. The sample consisted of 409 (158 men, 251 women) university undergraduates aged 18–30 years. Participants completed the Behavioural Regulations in Exercise Questionnaire-2, the visual analogue stage of change for exercise ladder, and a physical activity questionnaire. Linear discriminant function analyses revealed that men and women at the early stages were less self-determined in the regulation of their exercise behaviour than those at the later stages of change. Additionally, men and women who were more self-determined reported being more physically active over the previous 3 months. These results suggest that self-determination may have an important role to play in the adoption and maintenance of health-promoting behaviours in young adults.

Keywords: *Self-determination, stage of change, young adults*

Introduction

Engaging in regular physical activity has well-documented health benefits. However, far from optimal participation rates in physical activity are evident in most modern industrialized countries (Department of Health, 2004; US Department of Health and Human Services, 1996). Haase, Steptoe, Sallis and Wardle (2004) recently conducted a large survey of university students from 23 countries and reported that leisure-time physical activity was below that recommended in many students. Thus, it is important for researchers and practitioners to address the question of *why* young adults do or do not engage in health-promoting behaviour such as exercise, and to explore motivational factors that might discriminate between those who are active and those who are inactive. Biddle and Nigg (2000), in a review of several prominent theories of exercise behaviour, specifically highlighted the need for theoretically based research on the motivational processes linked to the com-

mencement and continuation of physical activity. Such work should provide greater insight into the mechanisms by which social environmental factors and individual differences impact on physical activity adoption and maintenance.

One framework that has only recently been applied to the study of variability in physical activity participation and the exercise experience is self-determination theory (Deci & Ryan, 1985; Ryan, 1995; Ryan & Deci, 2000). Self-determination theory is appealing because it specifies the various reasons for and meanings of behavioural engagement and the resulting consequences of adopting or endorsing different motives within particular domains (Deci & Ryan, 1985, 2000). In the long term, this information could help us to understand the impact of endorsing different regulatory styles in the exercise context (Wilson, Rodgers, Blanchard, & Gessell, 2003) and thus aid in the planning and development of health and exercise promotion interventions.

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Self-determination theory (Deci & Ryan, 1985; Ryan, 1995; Ryan & Deci, 2000) adopts a multi-dimensional approach to *why* some people engage in positive and adaptive health behaviours and others do not by examining the extent to which a person's motivation for a particular behaviour is relatively autonomous or controlled. A central focus of self-determination theory has been to conceptualize human motivation along a continuum, and several forms of behavioural regulation that vary in degrees of self-determination have been identified (Deci & Ryan, 1985). The self-determination continuum moves from more autonomous regulations to more controlling reasons for engagement in physical activity. The most self-determined behavioural regulation is intrinsic motivation. *Intrinsic regulation* is fuelled by the feelings of fun, personal challenge, and satisfaction endemic to the activity. The intrinsically motivated individual participates in the activity for no other reason other than what the behaviour provides itself. This type of regulation is entirely autonomous. *Identified regulation* is further along the self-determination continuum, as action is motivated by an appreciation of valued outcomes and is volitional. However, although the behaviour may be internalized when identified regulations are operating, it still is not completely self-determined because action is taken to achieve personal goals rather than for the joy of the activity itself. *Introjected regulation* refers to a more internal cause of behaviour whereby the individual internalizes the reasons for acting, but is not truly self-determined. Typically in this case, the individual is acting out of avoidance of negative feelings (e.g. guilt) but an introjected regulation is also evident when individuals want to prove to themselves and others that they can demonstrate a positive attribute or state. *External regulation* of behaviour is controlled by rewards and threats and reflects low self-determination on the continuum. In conjunction with the different regulatory qualities, Deci and Ryan (1985) have proposed that a state of amotivation can also exist. *Amotivation* is similar in nature to learned helplessness in that the individual has very little or no motivation to engage in an activity and sees no contingency between one's actions and the activity's outcomes. Amotivation is placed at the least self-determined end of the regulation continuum.

From a wider health promotion perspective, there are several practical reasons for distinguishing between autonomous and controlling regulations in exercise participation. Past research in the physical domain and other settings has indicated that positive motivational consequences (e.g. behavioural persistence, task involvement, enhanced psychological well-being, and quality of life) are positively associated with more autonomous regulations and/or

negatively linked to more controlling regulations (e.g. Reinboth, Duda, & Ntoumanis, 2004; Ryan & Deci, 2000; Sarrazin, Vallerand, Guillet, Pelletier, & Cury, 2002; Vallerand, Fortier, & Guay, 1997; Vansteenkiste, Simons, Lens, Sheldon, & Deci, in press). More specific to exercise participation, several researchers have reported that self-determined identified and intrinsic regulations are positively related to future intention to exercise, current exercise behaviour, and physical fitness in adults and young people in both exercise and leisure contexts (e.g. Chatzisarantis & Biddle, 1998; Edmunds, Ntoumanis, & Duda, in press; Landry & Solmon, 2004; Mullan & Markland, 1997; Rose, Parfitt, & Williams, 2005; Wilson & Rodgers, 2004; Wilson et al., 2003) and physical education contexts (e.g. Ntoumanis, 2005; Standage, Duda, & Ntoumanis, 2003). Daley and Maynard (2003) compared the effects of autonomy versus controlled exercise conditions on induced affect. They found that exercisers reported positive changes in affective responses during and after exercise when given the opportunity to be self-determined in the selection of their mode of exercise. Parfitt, Rose and Markland (2000) have also reported that exercisers are likely to exhibit a higher intensity work rate during preferred-intensity than prescribed-intensity exercise.

The relevance of self-determination to positive behavioural outcomes in other healthcare contexts has also been documented. For example, autonomous regulations have been found to predict greater adherence to medical prescriptions (Williams, Rodin, Ryan, Grolnick, & Deci, 1998), smoking cessation (Williams, Gagné, Ryan, & Deci, 2002; Williams et al., 2006), and weight loss (Williams, Grow, Freedman, Ryan, & Deci, 1996).

In understanding the motivation-related determinants of exercise behaviour, it is important to note that initiation and adherence to exercise have been conceptualized as multi-dimensional and dynamic. That is, it is assumed that individuals can move through a series of stages of exercise behaviour beginning at living a sedentary lifestyle to regularly maintaining an active life. Dishman (1982) has pointed to the utility and potential contributions of stage conceptualizations of exercise behaviours and several researchers have identified the transtheoretical model (Kirk, Mutrie, MacIntyre, & Fisher, 2003; Mutrie et al., 2002; Prochaska & DiClemente, 1983) as a potentially useful framework in this regard. Fundamental to the transtheoretical model is the assumption that the most positive outcomes will be observed when interventions are matched to the stage of change operating.

In the development of the transtheoretical model, Prochaska and DiClemente (1983) stated that exercise behaviour consists of a series of stages. The

stages of change are the core component of the transtheoretical model. The model hypothesizes that individuals progress through a series of stages of change: (1) precontemplation, (2) contemplation, (3) preparation, (4) action, and (5) maintenance. Movement across the stages is thought to be cyclic since many individuals do not succeed in their efforts to establish and maintain lifestyle changes (Prochaska, Norcross, Fowler, Follick, & Abrams, 1992). That is, individuals can relapse out of any stage and regress back to a previous stage.

Particularly with respect to the presumed enhanced effectiveness of stage-matched interventions to exercise promotion, there continues to be ongoing debate in the literature about the usefulness of the transtheoretical model (e.g. Adams & White, 2005). However, in previous work this approach has been used successfully to tailor interventions in a variety of exercise contexts (e.g. Dunn et al., 1998; Kirk et al., 2003; Marcus & Simkin, 1993; Pinto & Marcus, 1995). It has been suggested that interventions stemming from the transtheoretical model have tended to impact physical activity initiation rather than maintenance (Biddle & Mutrie, 2001). It is important to note, too, that the transtheoretical model is not an explanatory model – that is, it does not specify the mechanisms by which individuals change from one stage to the other, but rather distinguishes those in different stages.

In distinguishing the transtheoretical model from self-determination theory, the former assumes a more quantitative perspective on motivation. That is, this framework holds that individuals who are at higher stages of change are more motivated than those at lower stages. Self-determination theory, on the other hand, places emphasis on the quality of that motivation. This theory suggests that engagement in exercise can be regulated by more or less autonomous and controlled reasons. The assumption is that only when autonomous regulations are emphasized will regular (i.e. frequent) participation in physical activity be maintained. Thus self-determination theory (Deci & Ryan, 2000; Ryan & Deci, 2003) places emphasis on different processes of change than the transtheoretical model. Specifically, the process of integration, in which individuals' motivation for engaging in physical activity become less controlled and more autonomous over time, would be considered central to progress along the stages of change continuum.

With respect to empirical work addressing such issues, Landry and Solmon (2004), Mullan and Markland (1997), and Rose et al. (2005) have explored the relationship between self-determination in the regulation of exercise behaviour and stage of readiness to change for exercise specifically. As hypothesized in these studies, adults in the later

stages of change were more self-determined than those in the early stages of exercise change. However, it should be noted that these aforementioned investigations were characterized by modest sample sizes ($n=101$, 105, and 314 respectively), thus limiting their conclusions. Moreover, these earlier studies employed the Behavioural Regulations in Exercise Questionnaire (BREQ; Mullan, Markland, & Ingledew, 1997) to assess exercise regulations. It is important to note that this instrument does not contain a measure of amotivation. Given that a significant number of people in the UK are sedentary (Department of Health, 2004) or begin to engage in physical activity but do not possess the quality of motivation to maintain active living, it would appear that the amount of amotivation is pertinent to both the quantity and quality of exercise involvement. Thus, it would be prudent to re-examine the stages of change in terms of exercise behaviour and motivational regulations by considering the different forms of self-determined motivation, ranging from intrinsic motivation to the different types of extrinsic motivation to amotivation. This was the main aim of the present study.

Previous research (e.g. Fortier, Vallerand, Briere, & Provencher, 1995; Pelletier et al., 1995) involving several different populations (including university students) has revealed gender differences in behavioural regulations and participation in physical activity (e.g. Department of Health, 2004; Kearney, de Graff, Damkjaer, & Magnus Engstrom, 1999). However, several of the studies that have focused on the interdependencies between level of self-determination and physical activity participation specifically have included predominately women as research participants (e.g. Landry & Solmon, 2004; Wilson & Rodgers, 2004; Wilson et al., 2003). The present study focused on the link between behavioural regulations for exercise (ranging from autonomous to controlled regulations and including amotivation) and exercise engagement for males and females separately.

Another potential limitation of previous work is that Landry and Solmon (2004), Mullan and Markland (1997), and Rose et al. (2005) relied on a single measure of self-reported exercise (i.e. the study participants' stage of change). That is, they did not collect corroborating data about reported physical activity that would also allow participants to be classified according to their level of exercise behaviour. To enhance our understanding of physical activity behavioural patterns from a motivational perspective, the degree of engagement in the activity, such as is reflected in the frequency of participation, was considered in the present research along with the stage of change. It could be suggested that the frequency measure taps the quantity aspect of

people's physical activity engagement, while the stage of change provides some insight into the quality of that engagement, particularly in distinguishing between those who adopt exercise and those who maintain. This is because there should be some quality in a person's participation if he or she has persisted over time with the behaviour in question. Drawing from self-determination theory (e.g. Deci & Ryan, 2000), *quality* adoption as well as maintenance of physical activity is truly evident when such behaviour is autonomously motivated rather than controlled.

Young adulthood has been identified as a key developmental stage with respect to the adoption and maintenance of an active lifestyle (Dishman, 1994). Researchers (e.g. Barnekow-Bergkvist, Hedberg, Janlert, & Jansson, 1996; Sallis & Patrick, 1994) have shown that health behaviours established during individuals' younger years often transfer into middle and later adulthood. In the UK, a large proportion of young people attend university for 3 years or more, making student populations an important target group for health behaviour-related questions such as those posed in this study. Specifically, given that physical inactivity is a recognized risk factor in disease, and engaging in exercise appears to be a transferable skill that offers many potential health benefits for the future working population (Carney, Mutrie, & McNeish, 2000), obtaining insight into the motivation regulations undergirding university students' exercise engagement could help guide future exercise promotion strategies in this population. Thus, in the present study, the focus was on examining the interdependencies between exercise regulations, the reported frequency of physical activity engagement, and stages of change with respect to physical activity in a sample of university students.

Based on the theoretical propositions of self-determination theory and the transtheoretical model, our primary hypothesis was that motivational regulations for exercise would vary in accordance with the students' stage of change and reported physical activity behaviour. Specifically, we predicted that students who report less self-determined exercise regulations would correspondingly indicate being at the earlier stages of change and report a lower frequency of physical activity engagement than those who endorse more self-determined regulations.

Methods

Participants

The participants were 409 undergraduates (158 males, 251 females) from the North of England

who were enrolled on one of the following degree programmes: sport and exercise science ($n=149$), physiotherapy and diagnostic radiography ($n=81$), leisure management ($n=70$), biological/forensic/pharmaceutical sciences ($n=45$), and public health/nutrition/food marketing ($n=64$). They were aged 18–30 years (mean 19.9 years, $SD=3.0$).

Instruments

Motivational regulations in exercise. The 19-item Behavioural Regulations in Exercise Questionnaire-2 (BREQ-2) was used to measure exercise regulations consistent with the principles of self-determination theory. The BREQ-2 is an extension of the BREQ that was originally developed by Mullan et al. (1997). When the BREQ was first published it contained four subscales that measured varying degrees of exercise regulations, namely external ("I take part in exercise because my family/friends/partner say I should"), introjected ("I feel guilty when I don't exercise"), identified ("It's important to me to exercise regularly"), and intrinsic ("I exercise because it is fun") regulations. The BREQ-2, however, includes an additional subscale that assesses amotivation ("I think exercising is a waste of time"). Each subscale contains four items except introjected regulation, which contains three items. Following the statement "Why do you exercise?", participants are asked to respond to each item on a 5-point scale anchored by (0) "not at all true for me" and (4) "very true for me". Past research has provided support for the validity and reliability of the BREQ-2 in different exercise contexts (Markland & Tobin, 2004; Mullan & Markland, 1997; Wilson & Rodgers, 2004; Wilson, Rodgers, & Fraser, 2002).

Self-determination theory itself includes an additional form of extrinsic motivation labelled "integrated regulation". This behaviour occurs when identified regulations have been fully assimilated to the self (Ryan & Deci, 2000, p. 62). From a conceptual standpoint, integrated regulation is placed between identified and intrinsic regulation. However, this motivational regulation is not tapped in the BREQ (Mullan et al., 1997) or BREQ-2 (Markland & Tobin, 2004).

Stage change for exercise and participation in physical activity. The stage of change ladder (Beiner & Abrams, 1991) was used to assess participants' readiness to change and/or involvement in the exercise behaviour change process. The anchor labels represent the five items from the standard stages of change for exercise questionnaire (Marcus, Selby, Niaura, & Rossi, 1992). The change ladder is a visual-analogue measure. The labels at each stage represent the minimum requirements for

membership of a particular stage of exercise change with rungs in the ladder representing different stages of change for exercise. The maintenance (“I exercise regularly and have done so for longer than 6 months”) and action (“I exercise regularly but have done so for less than 6 months”) stages are at the top of the ladder and preparation (“I currently exercise some but not regularly”) is in the middle. The contemplation (“I currently do not exercise but I have been thinking about starting to exercise in the next 6 months”) and precontemplation (“I currently don’t exercise and I do not intend to start in the next 6 months”) are at the bottom of the ladder. Thus, it serves as a method for classifying individuals based on their current interest in physical activity together with their physical activity involvement. Evidence for the validity of this measure in exercise contexts has been provided by Marcus and Simkin (1993).

Regarding recent engagement in physical activity, the participants were asked how often they had taken part in one or more physical activities for 20–30 min per session during their free time in the previous 3 months: never, about once per month, about two or three times per month, about once per week, about twice a week, about three times per week, and about four times or more per week. This method for assessing exercise behaviour was based on previous research (Gionet & Godin, 1989; Godin, Jobin, & Bouillon, 1986; Godin & Shephard, 1985) and has been used recently to successfully classify participants according to their activity status (Godin, Lambert, Owen, Nolin, & Prud’homme, 2004). Furthermore, there is evidence to suggest that current physical activity can act as a reasonable indicator of future physical activity (Rhodes & Plotnikoff, 2005).

There were several reasons for including two separate measures of exercise behaviour. While the stage of change ladder provides a useful broad global assessment of participants’ reported initiation and maintenance of exercise behaviour and readiness to change (i.e. precontemplation and contemplation stages capture intentions for future engagement), it does not provide any specific information about the *amount* of physical activity that respondents have completed during previous weeks. Additionally, the stage of change ladder requires respondents to recall their exercise behaviour over the past 6 months (“I exercise regularly but have done so for less than 6 months”) and to consider their exercise intentions over the coming 6 months (“I currently don’t exercise but I am thinking about starting in the next 6 months”). However, asking respondents either to recall or to consider their behavioural intentions over 6 months could be considered too long a period. The physical activity question used, on the other hand, requested respondents to indicate

the amount (in terms of frequency) of physical activity that they have engaged in over the past 3 months.

Procedure

Questionnaire booklets were distributed to volunteer students at the end of one of their lectures. Data collection was completed over a 10-day period. Participants were informed that the instruments contained in the booklet examined their reasons for exercising and their current level of exercise participation. The participants also provided demographic information regarding their age, sex, and degree programme. The names of participants were not recorded. The questionnaire booklet took approximately 10–15 min to complete. Ethical approval for the study was gained from the local university ethics committee.

Results

Descriptive statistics and evidence for the validity and reliability of the BREQ-2

Spearman’s correlation analysis revealed a significant ($P < 0.01$) and high positive correlation between physical activity status and stage of change for exercise ($r = 0.74$, $n = 402$). Independent Pearson’s bivariate correlations were calculated separately for men and women to examine the hypothesized interrelationships between the BREQ-2 subscales (see Table I). As proposed by Ryan and Connell (1989), associations between motivation regulations varying in self-determination should reveal a simplex-ordered correlation structure. More specifically, adjacent motivational constructs should be more *positively* related with one another (e.g. amotivation and external regulation) than regulations more distal (e.g. external regulation and intrinsic motivation). As shown in Table I, the expected pattern of correlations was partially supported in the case of males and females in the present sample, thus providing partial evidence for the validity of the BREQ-2. Each of the subscales also exhibited good reliability, with alphas exceeding 0.9.

Data analysis

As a limited number of participants reported being in the precontemplation stage ($n = 18$), their data were combined with those classified as contemplators ($n = 62$) to form a single stage that was labelled “prepreparation”. While the combination of these two stages is not ideal, it is generally acknowledged that the first two stages of change are defined by intention and the last three stages of change relate to

Table I. Relationships among BREQ-2 subscales

Variable	Amotivation		External		Introjected		Identified		Intrinsic	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Amotivation	(0.93)									
External	0.35** (<i>n</i> = 151)	0.18* (<i>n</i> = 227)	(0.9)							
Introjected	-0.07 (<i>n</i> = 152)	-0.35** (<i>n</i> = 233)	0.31** (<i>n</i> = 153)	0.26** (<i>n</i> = 239)	(0.93)					
Identified	-0.48** (<i>n</i> = 152)	-0.62** (<i>n</i> = 239)	-0.17* (<i>n</i> = 153)	0.00 (<i>n</i> = 228)	0.47** (<i>n</i> = 152)	0.63** (<i>n</i> = 233)	(0.95)			
Intrinsic	-0.30** (<i>n</i> = 149)	-0.59** (<i>n</i> = 230)	-0.23** (<i>n</i> = 148)	-0.07 (<i>n</i> = 228)	0.20** (<i>n</i> = 149)	0.41** (<i>n</i> = 233)	0.63** (<i>n</i> = 150)	0.79** (<i>n</i> = 231)	(0.94)	

** Correlation significant at $P < 0.01$ (two-tailed). * Correlation significant at $P < 0.05$ (two-tailed). Cronbach's alpha estimates are placed along the principal diagonal.

a behavioural criterion (i.e. in this case, exercise engagement) (Marcus, Eaton, Rossi, & Harlow, 1994). Moreover, the combining of participants in the precontemplation and contemplation stages of change is an approach that has been used successfully in previous research by Landry and Solmon (2004), Mullan and Markland (1997), and Rose et al. (2005). Of the total sample, 20.8% reported being in the prepreparation stage, 23.7% in the preparation stage, 22.0% in the action stage, and 33.5% in the maintenance stage.

Based on their response to the physical activity assessment, participants were also categorized as "inactive" (two or three times per month, once per month or never), "low active" (once per week, twice per week), "moderately active" (three times per week), or "high active" (four or more times per week) with respect to their self-reported frequency of exercise engagement. Of the total sample, 19.6% were inactive, 27.4% low active, 23.7% moderately active, and 29.3% high active.

Tables II and III provide descriptive statistics for stage of readiness to change and physical activity status as a function of gender. As the present findings and previous research (e.g. Fortier et al., 1995; Pelletier et al., 1995) with several different populations (including university students) have revealed gender differences in behavioural regulations and reported participation in physical activity (e.g. Department of Health, 2004; Kearney et al., 1999), the data for men and women were analysed independently in subsequent analyses.

For the main analyses, linear discriminant function analyses were used to determine whether the BREQ-2 subscale scores could distinguish participants according to their stage of change and reported physical activity status. As advocated by Pedhazur (1982), variables with structure coefficients above 0.30 were considered to be good predictors and thus relevant to defining the meaning of the functions. Differences between participants at each stage of stage were evaluated by considering the values of the discriminant functions at the group centroids (i.e.

Table II. Descriptive statistics (mean and standard deviations) for men and women at each stage of readiness to change for exercise

Gender	Amotivation	External	Introjected	Identified	Intrinsic
Prepreparation					
Men (<i>n</i> = 20)	0.36 ± 0.52	0.91 ± 0.83	1.56 ± 1.34	2.82 ± 0.49	2.52 ± 0.83
Women (<i>n</i> = 48)	0.76 ± 0.75	0.64 ± 0.65	1.18 ± 0.86	1.82 ± 1.01	1.79 ± 1.18
Preparation					
Men (<i>n</i> = 32)	0.10 ± 0.21	0.45 ± 0.51	1.56 ± 1.03	2.90 ± 0.61	2.90 ± 0.62
Women (<i>n</i> = 56)	0.29 ± 0.50	0.61 ± 0.57	1.55 ± 0.93	2.55 ± 0.76	2.50 ± 0.86
Action					
Men (<i>n</i> = 35)	0.20 ± 0.51	0.57 ± 0.58	1.67 ± 0.99	3.01 ± 0.64	3.06 ± 0.64
Women (<i>n</i> = 51)	0.12 ± 0.35	0.61 ± 0.80	2.13 ± 0.95	3.11 ± 0.61	3.14 ± 0.84
Maintenance					
Men (<i>n</i> = 60)	0.10 ± 0.26	0.35 ± 0.54	1.99 ± 1.10	3.64 ± 0.46	3.50 ± 0.57
Women (<i>n</i> = 68)	0.08 ± 0.30	0.49 ± 0.68	2.15 ± 0.98	3.50 ± 0.50	3.44 ± 0.62
Total					
Men (<i>n</i> = 147)	0.16 ± 0.37	0.50 ± 0.61	1.77 ± 1.09	3.22 ± 0.63	3.14 ± 0.72
Women (<i>n</i> = 223)	0.29 ± 0.55	0.58 ± 0.68	1.79 ± 1.01	2.81 ± 0.97	2.78 ± 1.09

Table III. Descriptive statistics (mean and standard deviations) for men and women for each physical activity status category

Activity status	Amotivation	External	Introjected	Identified	Intrinsic
Inactive					
Men ($n=12$)	0.48 ± 0.61	0.93 ± 0.78	1.22 ± 0.84	2.70 ± 0.46	2.56 ± 0.71
Women ($n=50$)	0.78 ± 0.80	0.62 ± 0.62	1.12 ± 0.91	1.74 ± 0.95	1.62 ± 1.10
Low					
Men ($n=45$)	0.14 ± 0.24	0.59 ± 0.59	1.54 ± 1.13	2.88 ± 0.57	2.88 ± 0.76
Women ($n=58$)	0.31 ± 0.49	0.65 ± 0.67	1.66 ± 0.90	2.68 ± 0.66	2.77 ± 0.76
Moderate					
Men ($n=32$)	0.23 ± 0.55	0.50 ± 0.65	1.62 ± 0.96	3.16 ± 0.65	3.05 ± 0.64
Women ($n=61$)	0.07 ± 0.20	0.52 ± 0.68	2.03 ± 0.88	3.23 ± 0.59	3.22 ± 0.83
High					
Men ($n=60$)	0.07 ± 0.21	0.40 ± 0.54	2.13 ± 1.09	3.60 ± 0.43	3.48 ± 0.55
Women ($n=52$)	0.06 ± 0.25	0.52 ± 0.75	2.30 ± 0.96	3.48 ± 0.59	3.37 ± 0.65
Total					
Men ($n=148$)	0.16 ± 0.37	0.50 ± 0.61	1.76 ± 1.09	3.22 ± 0.62	3.13 ± 0.72
Women ($n=221$)	0.29 ± 0.55	0.58 ± 0.68	1.79 ± 1.00	2.80 ± 0.95	2.78 ± 1.07

the value of the discriminant function when the group is at its mean on each discriminating variable). Negative values indicate the group has a low score on a function, whereas positive values indicate the group has a high score on a function. Because of missing data, the number of participants for each analysis varied. To explore more closely possible gender differences, two-factor multivariate analyses of variance (MANOVA) were conducted on the behavioural regulation scores with gender as one of the independent variables and stage of change or physical activity status as the second independent variable.

Stage of change. The structure coefficients for stage of change are provided in Table IV. One discriminant function was significant for men (canonical $r=0.60$; Wilks' $\lambda=0.58$, d.f. = 15, $P<0.01$). This function accounted for 83.1% of the variance and was dominated by identified, intrinsic, and external (negatively weighted) regulations. As can be seen in Table IV, identified regulation featured most strongly on this function followed closely by intrinsic regulation. On this function, men who reported they were in the maintenance stage scored positively (0.80). In contrast, men who reported being in the prepreparation (-1.00), preparation (-0.62), or action (-0.24) stage scored negatively as indicated by the values from the discriminant function at the group centroids.

Analyses also revealed one significant function for women (canonical $r=0.70$; Wilks' $\lambda=0.52$, d.f. = 15, $P<0.01$) accounting for 93.9% of the between-groups variability. As demonstrated by the correlations between the discriminating variables and the discriminant function coefficients (see

Table IV), identified and intrinsic regulations dominated the function followed by introjected regulation. Amotivation loaded negatively on this function. An examination of the group centroids indicated that women who reported being in the maintenance (0.97) or action (0.44) stage scored positively, whereas women who reported being in the prepreparation (-1.42) or preparation (-0.37) stage scored negatively. Table IV provides the discriminant function structure coefficients and groups centroids for stage of change for both men and women.

Physical activity status. Table V presents the structure coefficients for physical activity status. Analyses revealed one significant function for men (canonical $r=0.57$; Wilks' $\lambda=0.61$, d.f. = 15, $P<0.01$) with a strong emphasis on identified and intrinsic regulations and, to a lesser degree, introjected regulation.

Table IV. Correlations between discriminating variable and discriminant function at each stage of readiness to change for exercise

Discriminating variable	Structure coefficients	
	Men	Women
Amotivation	-0.21	-0.56
External	-0.34	0.08
Introjected	0.25	0.47
Identified	0.84	0.97
Intrinsic	0.75	0.82
Group	Value of discriminant centroid function	
Prepreparation	-1.00 ($n=20$)	-1.42 ($n=48$)
Preparation	-0.62 ($n=32$)	-0.37 ($n=56$)
Action	-0.24 ($n=35$)	0.44 ($n=51$)
Maintenance	0.80 ($n=60$)	0.97 ($n=68$)

Note: The percentage of cases correctly classified was 53.1% and 45.7% for men and women respectively.

Table V. Discriminant function analysis for physical activity status

Discriminating variable	Structure coefficients	
	Males	Females
Amotivation	-0.30	-0.60
External	-0.25	-0.07
Introjected	0.42	0.48
Identified	0.94	0.94
Intrinsic	0.69	0.81
Group	Value of discriminant centroid function	
Inactive	-1.12 ($n=12$)	-1.62 ($n=53$)
Low active	-0.65 ($n=45$)	-0.14 ($n=60$)
Moderate	-0.11 ($n=33$)	0.65 ($n=61$)
High	0.78 ($n=60$)	0.95 ($n=56$)

Note: The percentage of cases correctly classified was 54.1% and 53.8% for men and women respectively.

This function accounted for 81.8% of the variance. Amotivation also approached the cut-off mark for inclusion in this function with a structure coefficient of -0.30. The group centroids indicated that men who were highly active had positive scores (0.76), whereas men who reported being inactive (-0.11), low active (-0.65), or moderately active (-0.11) had negative scores.

Analyses revealed one significant function for women (canonical $r=0.70$; Wilks' $\lambda=0.50$, d.f. = 15, $P<0.01$), accounting for 96.7% of the variance. Identified, intrinsic, and introjected regulations loaded strongly on this function, whereas amotivation weighted negatively (see Table V). More specifically, identified regulation featured most strongly in defining this function followed by intrinsic regulation. The centroid values indicated that highly (0.95) or moderately (0.65) active women had positive scores, whereas inactive (-1.62) or low active (-0.14) women scored negatively on this function.

Gender \times stage of change differences in behavioural regulations

The results of MANOVA revealed main effects for gender ($F=7.13$, $P<0.001$) and stage of change ($F=11.20$, $P<0.001$). In addition, a gender \times stage of change interaction emerged ($F=2.44$, $P=0.002$). Univariate analysis revealed gender differences for amotivation ($P<0.01$), identified regulation ($P<0.001$), and intrinsic regulation ($P<0.001$), with males reporting lower amotivation and higher identified and intrinsic regulation than females. Univariate tests also indicated significant differences for stage of change for all behavioural regulations collapsed across gender (in all cases, $P<0.001$). Follow-up Scheffé tests indicated that participants in the prepreparation stage reported higher amotivation scores than participants in all other stages (in all cases $P<0.001$). Participants in the preparation

stage reported higher external regulation scores than those in the maintenance stage ($P=0.02$). With respect to introjected regulation, participants in the preparation stage reported higher scores than those in the action ($P<0.001$) and maintenance ($P<0.001$) stages. Participants in the preparation stage reported lower introjected scores than those in the action ($P=0.04$) and maintenance ($P=0.002$) stages. Differences between each of the stages of change were recorded for both identified and intrinsic regulation scores, with scores increasing across the stages of change (in all cases, $P<0.01$).

Interaction effects were significant for amotivation ($P=0.004$), identified regulation ($P<0.001$), and introjected regulation ($P=0.004$). Scheffé's follow-up tests revealed that males in the prepreparation and preparation stages reported lower amotivation and higher identified and intrinsic regulation than females ($P<0.01$; Table II).

Gender \times physical activity status differences in behavioural regulations

The results of MANOVA revealed gender ($P<0.001$) and physical activity status ($P<0.001$) main effects as well as an interaction between the two ($P<0.001$). Univariate tests revealed gender differences in identified ($P<0.001$) and intrinsic motivation ($P<0.001$), with males reporting higher scores than females. Univariate tests also indicated physical activity category effects for amotivation, introjected, identified, and intrinsic regulation. Inactive participants reported higher amotivation than all other categories of activity status (in all cases, $P<0.001$). Participants who were low active reported higher amotivation than those who were high active ($P<0.01$). Inactive participants also reported lower introjected scores than all other participants (in all cases, $P<0.001$). Furthermore, low active participants reported lower introjected scores than active participants ($P<0.001$). Differences in both identified and intrinsic regulation were found for all physical activity status categories (in all cases, $P<0.001$), with mean scores increasing across the inactive to high active categories, with the exception of intrinsic regulation scores between moderately and high active.

Significant gender \times physical activity status category interaction effects emerged for amotivation ($P<0.01$), identified regulation ($P<0.001$), and intrinsic motivation ($P<0.01$). Scheffé's tests indicated that males and females in each physical activity status category differed from each other in reported amotivation ($P<0.01$), with males being lower in amotivation. Inactive males reported higher identified and intrinsic regulation scores than their female counterparts (Table III).

Discussion

Replicating and extending previous work (Landry & Solmon, 2004; Mullan & Markland, 1997; Wilson et al., 2003), we examined the interrelationships between exercise regulations, reported frequency of exercise, and stages of change for exercise in a sample of university students. In contrast to previous work in this area, exercise regulations were examined along the self-determination continuum ranging from more autonomous to more controlling regulations, including amotivation (or the state when a person does not know why he or she participates).

The results revealed that, on the whole for both men and women, the endorsement of more self-determined regulations distinguished between those who reported being at the later stages (maintenance and action) from those who were at the early stages of readiness to change for exercise (prepreparation and preparation). Very similar findings emerged for physical activity status as well; that is, more self-determined exercise regulations were evident in those participants who reported being active at least three times per week compared with those who were sedentary or active less than twice a week. Amotivation also contributed negatively to the between-groups variability, suggesting that feelings of non-contingency between engagement and outcomes were not dominant features in the regulatory profiles of frequently active participants who had maintained this behaviour for more than 6 months. Overall, the discriminant function analysis results for both men and women support our hypothesis that motivation regulations would vary and be aligned in a conceptually consonant manner with stages of readiness to change and reported level of physical activity. The consistent nature of the findings across the two physical activity classification measures provides evidence for the concurrent validity of the present results. The strong relationship between stage of change and behavioural frequency might also suggest that participants who reported being at a higher stage of readiness to exercise were able to carry out such intentions as evidenced in their reported high physical activity frequency scores. Thus, taken together, the results suggest that the maintenance of frequent participation in physical activity in this population is reflective of both the quantity and quality of motivation. The quality of the motivation is indicated by the more autonomous motivation underpinning the physical activity engagement.

In contrast to the findings of Ingeledew, Markland and Medley (1998) but similar to those of Landry and Solmon (2004) and Mullan and Markland (1997), only one significant discriminant function emerged; this was both interesting and disappoint-

ing. This finding is interesting because it does provide evidence to support the propositions of self-determination theory. That is, the emergence of a single discriminant function supports the premise that all of the behavioural regulations can be situated on one single continuum ranging from low (amotivation) to high (intrinsic) self-determined motivation. However, a counter-argument might be that our findings are therefore somewhat unsurprising and predictable. It could be considered more provocative if more than one linear combination of motivational regulations distinguished between groups based on the stage of change and frequency of physical activity. Nevertheless, the present results are consistent with the theoretical arguments proposed by self-determination theory and findings from previous research (Landry & Solmon, 2004; Mullan & Markland, 1997; Rose et al., 2005; Wilson & Rodgers, 2004). These researchers found that higher self-determination appeared to be a prerequisite for participation in regular exercise and classification into one of the higher stages of readiness to change for exercise.

Identified rather than intrinsic regulation consistently loaded the strongest on the discriminant functions suggesting that exercise is a behaviour that tends not to be especially engaged in and maintained due to high intrinsic interest alone. Thus exercising to achieve an outcome, rather than for the intrinsic joy of physical activity participation *per se*, emerged as the most influential motivational regulation in discriminating active from inactive participants. Interestingly, while Rose et al. (2005) reported that more self-determined regulations increased across the stages of change, intrinsic regulation did not increase as a function of longer involvement in exercise.

According to self-determination theory, intrinsic motivation should be tied to the most positive motivational consequences. However, similar to our findings, previous research in the physical domain (e.g. Standage et al., 2003) and other settings (e.g. Koestner, Losier, Vallerand, & Carducci, 1996) has found identified regulation to more strongly predict positive behavioural outcomes than intrinsic regulation. Such results pose an interesting dilemma in terms of potential strategies for promoting participation in exercise. The quandary exists because self-determination theory suggests that intrinsic regulation (as the most self-determined regulation) is associated with more beneficial and adaptive behavioural, cognitive, and affective outcomes. However, it is important to consider that "the pursuit of the behaviour [exercise] itself fails to invoke uniformly high levels of intrinsic interest" (Wilson & Rodgers, 2004). Put in context, we should be cognisant of the point that, although

some people do enjoy participating in exercise, in and of itself, a great deal of exercise behaviour is not *inherently intrinsically* interesting (Ryan, Frederick, Lepes, Rubio, & Sheldon, 1997). Our results support Ryan's (1995) proposition emphasizing the important contribution of other types of more self-determined regulations (i.e. identified and to a lesser extent introjected) in nurturing positive health-promoting behaviours in the form of exercise frequency and adherence.

Another possible explanation for the more dominant influence of identified regulation in this study is related to the predominant "marketing" or "benefits" approach in exercise-related public health campaigns in modern industrialized nations. Such messages tend to emphasize the importance of exercise to health and social benefits. Typical health messages tend to promote exercise as a means of weight loss, improving cardiovascular fitness, physical functioning, quality of life, as well as an opportunity to meet people. The intrinsic value or outcomes associated with participation in exercise (e.g. "it" feels good, exercising is fun) appear to be less salient features within typical exercise campaigns. Perhaps this is a strategic decision by health-promotion agencies based upon the notion that individuals are more likely to commit to a lifetime of regular physical activity if there is "something in it for them". Thus, it might have been the case that more active participants in this study were more able to identify with questions in the BREQ-2 related to the benefits of exercise ("I think it is important to make the effort to exercise regularly"; "I value the benefits of exercise") because this is how exercise is "sold" to them. They might well find exercise to be intrinsically enjoyable, but the primary source of self-determined motivation comes from the outcomes that may be obtained from participation in exercise.

Wilson and associates (2003) have suggested that altering dysfunctional exercise habits (e.g. a sedentary lifestyle) might be achieved through the development of identified regulations for physical activity engagement. Before we adopt such an intervention strategy, however, it is important to keep a number of points in mind. First, as in the present study, most research reporting positive behavioural outcomes to be more closely tied to identified rather than intrinsic regulations have been cross-sectional in design. To more aptly determine the advantages or disadvantages associated with any motivation regulation, it is critical to examine the correlates of that regulation over time. Previous longitudinal research in the physical domain (e.g. Sarrazin et al., 2002) and other settings (e.g. Pelletier, Fortier, Vallerand, & Briere, 2001) has found intrinsic motivation to be the key predictor of persistence in the activity at

hand. Indeed, Deci and Ryan (2000) and Ryan and Deci (2003) argue for the process of integration in terms of the maintenance of adaptive behavioural engagement. Integration occurs when individuals being to assimilate, reconstitute, and internalize more extrinsic reasons for participation in physical activity and thus become more self-determined. That is, through the process of integration people eventually engage in the behaviour out of personal choice and because it is consistent with the self. Finally, in terms of promoting identified regulations in the physical domain, it is important to acknowledge that in the current study the observed mean for intrinsic regulation was high. Thus, although identified reasons for exercise participation appear linked to more active exercise patterns, intrinsic motivation is "alive and well" in exercise settings.

Based on the present findings and results of previous research, it would appear that the next step is to examine the interdependencies between motivational regulations and exercise participation over time. Longitudinal studies would provide a suitable method for examining what most likely are recursive effects and allow a more appropriate test of the theoretically predicted process of integration and behavioural change (Deci & Ryan, 2000; Ryan & Deci, 2000).

Gender differences

Analyses indicated that, overall, men reported higher identified and intrinsic regulation than women. Specifically, women who were contemplating exercise (i.e. in the prepreparation stage) or who were inactive had less self-determined regulations for exercise than men. The emergence of intrinsic as well as identified regulation as important variables discriminating between stage of change and physical activity status categories for men and women alike is consistent with research by Mullan and Markland (1997) and to some extent that of Landry and Solmon (2004). The present study only partially supports the work of Rose and associates (2005), who did not find intrinsic motivation to define the function in women. Rather, Rose and colleagues found the less self-determined motivations of identified and introjected regulation were more important to distinguish between those women in the action and maintenance stages from those in the prepreparation and preparation stages. For men, however, Rose et al. (2005) reported that high intrinsic and identified regulation discriminated those who exercised from those who were preparing to or not considering exercise. The results of Rose and colleagues are not entirely aligned with the findings of the present study and similar research conducted in other settings and among different populations

(e.g. Vallerand & O'Connor, 1989) that have found women to be more self-determined than men.

It is interesting that the significant functions for stage of change and physical activity status discriminated positively for women who were in the action and maintenance stages (and who were moderately or highly active). That is, women who had reached the action stage and/or who were moderately active reported experiencing high self-determined reasons for exercise and expressed very low amotivation. However, this was not the case for men, as the significant self-determining functions only discriminated positively those men who were in the maintenance stage (and who were highly active) from those in the other three stages. Put another way, men in this study who were at the action stage and/or who were moderately active reported relatively similar low self-determined reasons for exercise as men at the prepreparation and preparation stages and/or who were infrequently or not active. Such findings intimate that men, who exercise regularly but have not done so for more than 6 months, might be susceptible to dropout from participation in exercise due to the relatively less self-determined regulations that they hold. The action stage is a pivotal point in the exercise change process and it serves as a "holding" stage before entry into maintenance.

Thus it could be said that the current findings call for greater efforts to foster more self-determined exercise regulations in young men who are at the action stage of change so that they can move on to the maintenance stage. Based on the findings, the same suggestion would also be true for young adults (men and women) who are infrequently active or sedentary. However, if the results are taken in their entirety, the same proposals are warranted for both young adult males and females with respect to promoting physical activity; namely, there is a need to encourage autonomous motivation for physical activity engagement in both males and females.

Although the present study has a number of methodological strengths, the findings should be interpreted in light of potential limiting factors. Previous research examining stages of change has recognized that using the stage of change ladder only allows data to be collected from one instant in time. Consequently, in some circumstances this could be too broad an approach to accurately categorize the exercise patterns of participants. This concern reinforces the importance of including reports of participants' recent exercise habits alongside stage of readiness to change.

It should also be noted that the study used a cross-sectional design, thus limiting the strength of any conclusions that can be made. Moving beyond longitudinal work, we eventually need large, well-designed randomized controlled trials to provide

causal evidence regarding self-determination theory's propositions on the link between internalization of behaviour and behavioural engagement. Furthermore, it is important to note that the physical activity measures used in the present work, as is the case in most research on motivation and exercise, were self-report. Thus, subsequent studies might consider including more direct and objective methods of physical activity assessment. Lastly, few participants in the current study were classified as precontemplators; thus, future investigations might strive to obtain an even broader, more heterogeneous sample specifically to test the behavioural regulations emphasized by this group of individuals. Such research should also take into account the fact that past investigations (Godin et al., 2004; Kraft, Sutton, & McCreath Reynolds, 1999) have indicated that the precontemplation and contemplation stages are sufficiently similar with respect to attitudes and intention to warrant considering them as a single stage. Moreover, while different algorithms have been used in the transtheoretical model (Richards Reid, Velicer, Prochaska, Rossi, & Marcus, 1997), it is generally acknowledged that the precontemplation and contemplation stages are defined by intention and the last three stages are related to behaviour (Marcus et al., 1994; Prochaska & Marcus, 1994). As a result, the motivational orientations of the precontemplation and contemplation stages are not hypothesized to be different.

In conclusion and in accordance with self-determination theory, our results suggest that self-determination with respect to exercise behaviour may well play a role in shaping individuals' readiness to take up exercise and subsequent physical activity patterns. Drawing from such work and previous studies, a worthwhile aim is to begin to design physical activity interventions that are aimed at promoting feelings of self-determination for exercise. Grounded in self-determination theory, such interventions would strive to foster perceptions of choice, personal mastery, fun, and the excitement of exercise, particularly among those who are not active on a regular basis. Moreover, it is important that the value of physical activity (in terms of physical, psychological, and emotional benefits) is made more explicit in such applied endeavours.

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